Hemispheric Center for Environmental Technology

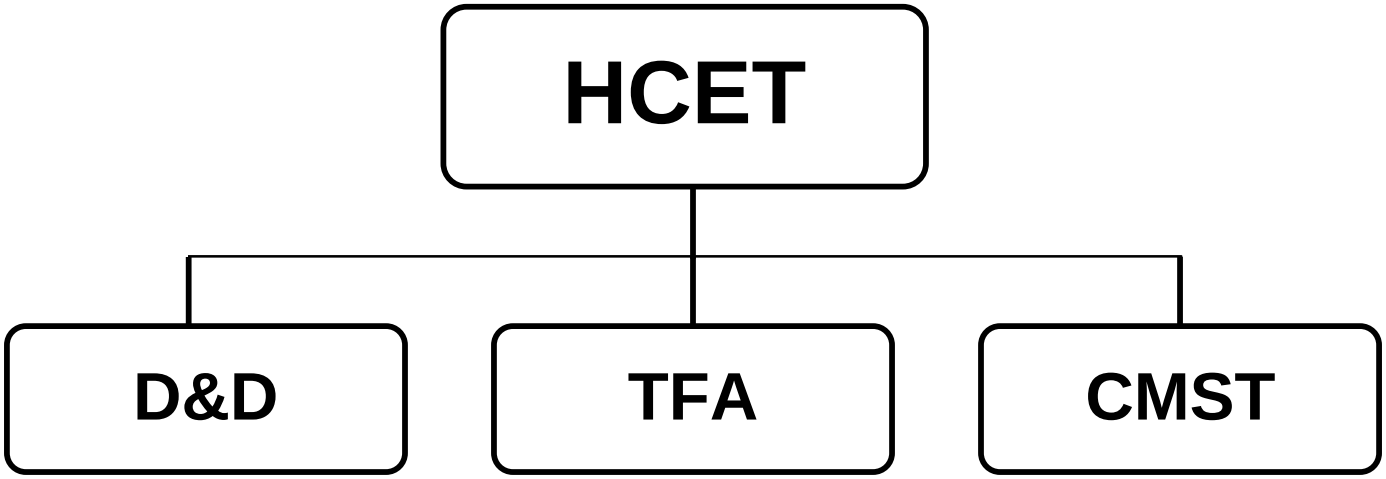
Research & Development Capabilities

Joseph F. Boudreaux, Program Manager

Florida International University

Miami, Florida 33199

HCET's Work for DOE-OST



Decontamination and Decommissioning Focus Area

Hemispheric Center for Environmental Technology

Florida International University

Current Initiatives

- **Latin America's Decontamination & Decommissioning Needs**
- **Decision Analysis Science Modeling for Application and Fielding Selection Applied to Metal Decontamination Technologies**
- **Decision Analysis Science Modeling for Application and Fielding Selection Applied to Concrete Decontamination Technologies**
- **Technology Assessment for Improved Structural Demolition and Dust Suppression**
- **Melting, Solidification, Remelting and Separation of Glass and Metals**

Current Initiatives

- **Microwave Combustion and Sintering Without Isostatic Pressure**
- **DOE-CP 5 Reactor Facility Large Scale Demonstration**
- **DOE-Fernald Plant 1 Large Scale Demonstration**
- **DOE-Hanford 105-C Reactor Interim Safe Storage Large Scale Demonstration**
- **DOE-Fernald Analysis of Potential Concrete Decontamination Technologies**
- **DOE-Chicago Investigation of Potential Decontamination and Decommissioning Technologies**
- **Evaluation of Coating and Concrete Removal Techniques for Vertical Surfaces**

Decision Analysis Science Modeling for Application and Fielding Selection Applied to Metal and Concrete Decontamination Technology

Fundamental Need

- **A comprehensive set of comparable data for coating/rust removal of metal surfaces and concrete removal technologies is needed by project engineers during the decision-making process to determine the safest and least cost options**
- **Technology assessment information is required to aid in the evaluation of innovative technologies**

Objectives and Benefits

- **To collect comprehensive and comparable data related to operations and maintenance, health and safety, and secondary waste generation**
- **This data will aid in the decision-making process to determine the most suitable technology, given a set of site-specific parameters**
- **Multi-Objective or Multi-Criteria Decision-Making (MODM) techniques will allow best technology(s) to be selected, in order to achieve decontamination objectives**
- **Testing will allow innovative technologies to be compared under identical field conditions to baseline technologies**
- **Additional nuclear commercial technologies will be evaluated**

Status - Coating Removal Metal

- **Eight technologies were evaluated during FY95**
- **Technologies tested in FY96:**
  - **Pentek, VAC-PAC, Roto-Peen and Needle Gun System**
  - **LTC Americas, Power Tool Center**
- **Technologies proposed to be tested:**
  - **Polygon, Inc., Flashlamp Technology**
- **EM-50 technologies proposed**
  - **F2, Laser Ablation**
- **International Union of Operating Engineers (IUOE) provided assessment of human factors for technologies tested**

Status - Concrete Surface Removal

- **Technologies already tested:**
  - **3M - Roto Peen Technology**
  - **Pentek**
  - **Ultra High Pressure Water**
  - **Centrifugal Shot Blasting**
  - **Grit Blasting**
- **Scheduled to be tested**
  - **Laser Ablation (Coating Removal)**
  - **ROVCO2 (Coating Removal)**
  - **Electro-Hydraulic Scabbling**
  - **Microwave Decontamination**

Technology Assessment for Improved Structural Demolition and Dust Suppression Techniques

Fundamental Need

- **To provide the Department of Energy with a tool by which D&D personnel can determine:**
  - **Assessment of current and innovative D&D technologies**
  - **Evaluation of dust suppression methods, and find extrapolating factors that can be applied to D&D work**
- **To develop a focus on improving health concerns in D&D**
- **To encourage the development of technologies with improved safety factors**

Objectives and Benefits

- **To assess existing technologies, thus providing a central data source for demolition technologies**
- **To assess dust suppression techniques for demolition methods**
- **To provide demolition personnel and industrial hygienists with a central data source for the demolition of structures, using correlated data and factors impacting health concerns**

Status

- **Data acquisition in progress**
  - **Base data to establish dust suppression methods**
  - **Use of different dust suppression techniques and compare to baseline data**
  - **Correlation of data to be applied to D&D work**

Melting, Remelting, Solidification and Separation of Glass and Metals

Fundamental Need

- **Efficient slag/metal separation methods are needed for the vitrification and metal recycling process to reduce the contamination level in the final metal product for reuse**
- **Knowledge about melting, remelting, and solidification phenomena of metal and slag are needed for the new technology development**

Objectives and Benefits

- **Development and implementation of measurement methods for the metal and glass melting and solidification tests**
- **Investigation of melting and solidifying characteristics of glass and metals and their mixtures**
- **Design and lab test of new or improved separation methods**
- **Improvement of the vitrification and recycling process**
- **Slag/metal clear separation for reuse of metals**

Status

- **Technology assessment and melting solidification experimental setup design have been completed**
- **Conceptual designs of separation technologies have been finished, and patent applications for these designs are in process**
- **Melting and solidification tests are being conducted**
- **Principle demonstration separation units using simulants are being constructed**

Decontamination Information System

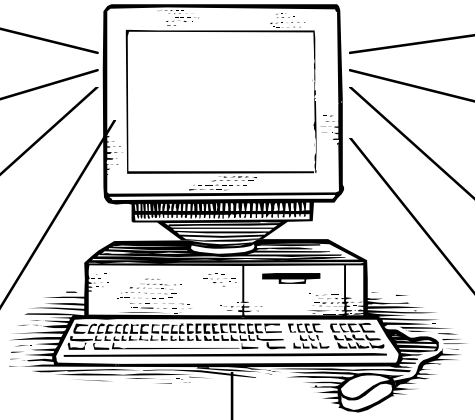
- There are many technologies and technology sources available to solve decontamination objectives
- Technologies range in aggressiveness, cost, health and safety concerns, and waste management issues
- There is no comprehensive source of information available to the Decontamination Engineer to choose the safest and least cost option
- This lack of data may cause the wrong technology to be selected, potentially increasing project cost and exposing personnel to safety hazards
- A comprehensive comparable source of data is required to ensure selection of the safest and least cost option, based on site-specific needs

Solutions

- **Perform technology assessments to gather comprehensive and comparable data**
  - **Metal Decontamination Assessment Phase I: Complete**
  - **Concrete Decontamination Assessment: Complete**
  - **Metal Decontamination Assessment Phase II: Ongoing**
  - **Piping Assessment: Ongoing**
  - **Concrete Wall Assessment: Ongoing**
  - **Equipment Dismantlement: Proposed FY97 work**
- **Develop interactive Information System to access comprehensive data set**

Information System Features

Graphical User Interface



Human Factors

Production Rates

Secondary Waste Generation

Applicable Surface

Health and Safety Information

Capital Costs

Operating/Maintenance Requirements

Achieved End Points

Equipment Requirements

Information System Benefits

- **Multimedia Fields**
  - **Still photographs of equipment**
  - **Video clips of equipment description and capabilities**
- **Reports/Queries**
  - **Technology Overview**
  - **Equipment Requirements**
  - **Health and Safety Concerns**
  - **Operational Parameters**
  - **Utility / Media Requirements**
  - **Vendor Data**
  - **User Defined Reports / Queries**

Future Developments

- **Access from the Internet**
- **Development of similar Information Systems for Characterization, Dismantlement, and Waste Management**
- **Interaction with cost model to determine least cost option based on site-specific concerns**

Tank Focus Area

Hemispheric Center for Environmental Technology
Florida International University

Current Initiatives

- **Nitrate to Ammonia and Ceramic (NAC) Process for the Denitration and Immobilization of Low Level Liquid Waste**
- **Rheology Control of Defense Waste Processing Facility (DWPF) Melter Feeds**
- **Experimental Investigation and Model Development of Waste Glass Crack Behavior**
- **Waste Glass Performance Evaluation**
- **Improved Waste Slurry Mixing and Sampling Systems**
- **Investigation of the Waste Glass Pouring Process in the Defense Waste Processing Facility (DWPF) Melter**

Nitrate to Ammonia and Ceramic (NAC) Process for Denitration and Immobilization of Low Level Liquid Waste (LLW)

Fundamental Need

- **Tons of low-level radioactive waste (LLW) have been generated during the production of nuclear weapons materials**
- **Most of this waste is currently stored in 300 underground storage tanks throughout DOE facilities**
- **To minimize the risk of seepage into groundwater supplies, the waste must be immobilized before final disposal**
- **The NAC process has been selected by the DOE as one of the technologies used to treat tank wastes**

Objectives and Benefits

- **To obtain the necessary operational parameters for the Nitrate to Ammonia and Ceramic (NAC) process during continuous operation**
- **Results can be used for the design of a pilot scale plant to process the LLW from DOE sites and eventually go to full scale operation**
- **Determine the quality and characteristics of the final waste form and compare with other currently used waste forms**
- **Obtain an understanding of the three-phase product slurry's rheology and heat transfer behavior and implement those findings in the pilot-scale plant design**

Status

- **Reactions in the continuous operating mode have been performed for the Hanford & MVST simulants**
- **One of the major results indicate that decreasing the temperature significantly improves the nitrate destruction efficiency**
- **Final ceramic product is being collected and samples are being prepared for evaluation of the waste form**
- **Three-phase experiments for the NAC product have been completed on the subjects of rheological properties and heat transfer behavior**

Rheology Control of Defense Waste Processing Facility (DWPF) Melter Feeds

Fundamental Need

- **The Defense Waste Processing Facility (DWPF) is implementing advanced technologies for treatment of low and high level wastes**
- **Vitrification process is one of the technologies used to immobilize radioactive wastes in glass form**
- **The process design and modification for handling and transportation of vitrification melter feeds require detailed information on their rheological properties**
- **Refined and reliable experimental data on the properties will enhance the process design and operation**

Objective and Benefits

- **To determine and control the rheological properties of slurry, which represent those currently stored in tanks across the DOE complex or which result from the retrieval processes**
- **To measure and analyze the feed rheology behavior at different levels of solid concentration, pH value and temperature**
- **Correlation of the experimental data with rheology model and transition of the resultant to DOE sites and industrial users**
- **These results could be used as technical bases for designing waste slurry mixing, handling, and transportation systems**

Status

- **The simulants investigated included the Savannah River Site-Batch One slurry and Hanford simulant. Experimental observation indicates that the solids concentration and slurry pH exert a strong effect on the viscosity**
- **The rheological properties of SRS slurry were also investigated in a pipeline system for flow rate (10, 20, 30 LPM), temperature (30, 55, 65^{o}C), concentration (15 and 24 wt.%), and pH (from 4 to 13.5)**
- **A mathematical model was developed to describe the effects of the solids concentration on the viscosity of the slurry. The model has successfully been used to predict the slurry viscosity. This model is under modification to consider the influences of other parameters**

Characterization, Monitoring, and Sensor Technology Focus Area

Hemispheric Center for Environmental Technology

Florida International University

Current Initiatives

- **Characterization of Transport and Solidification in the Metal Recycling Process**
- **Sensor for Viscosity and Shear Strength Measurement**
- **Dielectric Properties of Low Level Liquid Waste**

Characterization of Transport and Solidification in the Metal Recycling Process

Fundamental Need

- **The analysis method is needed to characterize radiologically contaminated scrap metal (RSM) recycling products to evaluate the recycling process**
- **The data of the radionuclide transfer and distribution during the melting and solidification process of metals is critical for the RSM recycling technology development**
- **The understanding of the transport phenomena in molten metal solidification is required to control and monitor the recycling process**

Objectives and Benefits

- **To develop and implement a characterization process to study the radionuclide distribution in metal ingot**
- **To characterize radionuclide distribution in metal ingot after melting and solidification**
- **To simulate and characterize the transport and metallurgic phenomena in the metal solidification process**
- **This project will provide a characterization method and basic information for RSM recycling, which converts RSM into usable non-contaminated metals and effects a significant savings from disposal avoidance**

Status

- **A characterization process has been implemented using the SEM/EDS as the analysis system**
- **Five tests have been conducted to study the radionuclide surrogate distribution and microstructures in aluminium and copper ingots after melting and solidification**
- **The temperature distribution, solidification pattern, and flow field in molten metal pool have been numerically simulated for molten aluminium and iron steel solidification in a cylindrical crucible**

Sensors for Viscosity and Density

Fundamental Need

- **To measure the rheological properties of tank slurries, both in transport pipe (viscosity < 30 cps) and within storage tanks (viscosity 1,000-10,000 cps)**
- **Provide sensors which are robust and radiation tolerant, and miniaturized through the use of microelectronics for minimal invasive impact**

Objectives and Benefits

- **To evaluate non-mechanical methods to measure rheological properties in the corrosive and radioactive environments of tank slurries**
- **Developed two novel sensors (one mechanical, one non-mechanical) which did not duplicate existing commercial instrumentation on research projects for viscosity within current CMST funding**

Status

- **Developed the Torsional Waveguide Viscometer, a viscosity and density sensor based on transmission time of an elastic torsional wave through a cylinder immersed in a fluid. The sensor has a wide operating range for viscosity measurement (20-20,000 cps)**
- **Developed the Oscillating Cylinder Viscometer, based on theoretical calculations, which allows decoupling of viscosity and density**
- **Patent applications for these designs are pending**

Dielectric Properties of Low Level Liquid Waste (LLW)

Fundamental Need

- **A comprehensive source of data for dielectric properties of low-level liquid waste is needed for the development and optimization of solidification technologies**

Objectives and Benefits

- **To obtain a comprehensive data source for dielectric properties of various LLW simulants**
- **The obtained information will help optimize solidification technologies such as the microwave process**

Status

- **A total of eight simulants/recipes were obtained from DOE sites and national laboratories**
- **Test set-up was designed and constructed**
- **Obtained simulants/recipes were tested over a temperature range of 20^{o}C to 100^{o}C and a frequency range of 0.05 to 20.0 GHz**
- **Green book was developed**
- **Final report is being prepared**